



Government of Northern Rhodesia.

Department of Agriculture.

ANNUAL REPORT

For the Year 1932.

LIVINGSTONE :
PRINTED BY THE GOVERNMENT PRINTER
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DEPARTMENT OF AGRICULTURE.

Annual Report for the Year 1932.

Throughout the year the acting Secretary for Agriculture, Captain J. Smith, was in charge of the department. Captain Smith retired at the end of December. Previous to his assumption of office in 1925 the department was practically non-existent; it is a matter for profound regret that the close of his service should have seen the temporary curtailment of an organisation which owed much to his energy and foresight. Through his retirement the Government has lost an able adviser, the department a sympathetic chief and the farming community a true friend.

ESTABLISHMENT.

2. Financial difficulties have naturally reacted on the establishment of the department, though the extent to which the staff has been reduced is perhaps not generally realised. The European staff changes are summarised in the following table :

					Officers employed on	
					1-1-1932	1-1-1933
Administration	...	...	...	...	2	1
Clerical ...	...	...	...	...	4	2
Agriculture	...	...	...	...	12	9
Forestry	...	...	...	...	3	4
Water-boring	...	...	...	...	2	1
Maintenance	...	...	...	...	1	1
LOAN STAFF :						
Agricultural Survey	...	...	...	...	3	Nil
Ecological Survey	...	...	...	...	1	2
New Capital	...	...	...	...	Nil	1
Water-boring	...	...	...	...	1	Nil
					—	—
					29	21
					—	—

In addition, before the end of the year, provisional notice was served on two other officers of the agricultural section. Changes of this order, accompanied by drastic cuts in other expenditure, must inevitably react on efficiency or must narrow the scope of departmental activities, but as each member of the staff has cheerfully assumed the burden of new duties it is hoped that if the process of retrenchment can be but stayed, the effect will become evident rather in a slowing down of progress than in retrogression. I am confident that my predecessor would desire that appreciative mention be made of the loyal manner in which the staff has quietly continued its work in these difficult and uncertain times.

3. It must be admitted that in a Territory such as this, where the economic problems of the agricultural industry are overwhelmingly more important than those which may yield directly to scientific investigation, there is some justification for regarding an agricultural department as a "non-essential service". Yet it is in no sense a luxury. At least one-half of the native population is ill-fed and the formation of native reserves has imposed artificial conditions which must eventually lead to radical changes in the traditional agricultural systems, changes which need expert guidance if they are to be accomplished without misery and want. This alone, apart from any help it may give the settler, renders the continued existence of the department on a reasonably effective scale highly desirable even in these times of economic stress.

ARABLE FARMING CONDITIONS.

4. The Department is directly concerned only with the plant industry branch of agriculture. The following remarks on general farming conditions and on the importation of agricultural produce are similarly restricted in their application.

5. The prosperity of the farming community on the railway line is almost entirely dependent on maize. Despite much which has been said to the contrary, the cause of the depression in arable farming, prior to June, 1932, is attributable to the low yields of the 1929-30 and 1930-31 crops and to the uneconomical manner in which maize, as a whole, is produced. While, owing to external competition, anxiety regarding disposal existed at times, prior to this date the internal market and the Belgian Congo could and did absorb almost all our produce. The prices can hardly be described as high, particularly when compared with those ruling a few years ago, but within the short space of one year opinion as to values has so changed that they are now regarded with envy. These prices, which varied between 9s. and 11s. per bag on the farm, did at least represent a fair living for the efficient producers but when the average yield for two consecutive years did not exceed 4.5 bags per acre, it is not difficult to see why the majority of maize farmers were not paying their way.

6. The cause of the new and much more intense depression is the exact opposite of its predecessor. While there previously existed large markets and small crops, now a greatly restricted market is unable to absorb a record output even though no external competition exists. Prior to the entry of the new crop there was actually a shortage of maize and small imports were necessary to ensure the eking out of supplies. The advent on the market of an unprecedented crop of 250 thousand bags naturally had a catastrophic effect on price for, in the absence of a miracle, it was obvious that when allowance was made for traded grain, the surplus over the year's requirements would be almost half the European production. The surplus, intrinsically small though it is, is of such magnitude in relation to the size of the industry to be a serious embarrassment for it cannot be exported save at ruinously low prices. Though the final "pay-out" per bag will be much smaller than that of the last two years, the sale of a greatly increased number of bags affords material compensation. Probably the most serious aspect of the matter is the inevitable delay in receiving payment.

Maize Control.

7. The Co-operative Society handles 80 per cent. of the settlers' grain. Thus, while independent traders had some chance of disposing of their holdings locally, the Society was bound to carry a large surplus which could only be exported. Holding the view that the burden of export should be distributed among all growers whether native or European, the Farmers' Associations and the Society requested Government to consider the application of a Maize Control Act. This matter was receiving careful attention at the end of the year.

The Maize Industry.

8. The maize industry is the sheet anchor of arable farming yet its structure is faulty and its holding-ground none too secure. It is a low priced product and therefore can only be produced economically if the overhead charges are spread over a large number of bags. Yet with few exceptions outside the Chisamba area, the production per farmer is so low as to render a profit, quite apart from an adequate living, impossible.

The Small Producer.

9. In the season 1930-31 over two-thirds of the growers in the railway belt produced less than 1,000 bags per head for sale. In this class the average production for sale was but 400 bags per farmer. In the favourable 1931-32 season a similar proportion produced less than 1,500 bags per head with an average production per farmer of 700 bags. In few instances do other arable operations relieve the maize crop of such a proportion of the overhead charges as to render production on this scale profitable, and there must be many men who, when their remaining capital and credit is exhausted, will be forced to abandon arable farming altogether.

The Large Producer.

10. On the other hand there has arisen in recent years a class of farmer which has not only realised that maize offers an adequate livelihood only to the producer of large crops but which has had sufficient capital to attain this end. These men produce upwards of 4,000 bags per annum and as a rule practice a very high standard of farming. Their low costs of production enable them to weather periods of price depression and their position is unassailable except by the native producer. Moreover a return of maize to the 1929 or even the early 1930 level on Baltic Exchange would permit them to enter the export market with profit. Much ill-considered criticism has been levelled against this class of maize farmer during the past year. It has been blamed for the present overproduction and for the prospect of continued overproduction. Such criticism is obviously devoid of weight.

The internal market for alternative crops.

11. It is only within the last few months that smallness of the internal market has received general recognition. Even in June when the Finance Commission was taking evidence, representative farmers appeared to be under the delusion that large quantities of foodstuffs were being imported which might be produced in this Territory. In its report on the agricultural section of the Research Station, the Finance Commission gave publicity to this evidence but it did not comment on it: "It was freely suggested that more attention should be paid to investigations which would stimulate the production of such agricultural products as are at present imported in large quantities from neighbouring territories".

12. What are these agricultural products? Analysis of Customs figures for 1932 shows that the net import of crops which can be produced here is almost negligible. Assuming that over-importation did not occur, it is calculated that our requirements could have been met had each farmer in the railway belt grown an extra one-sixth of an acre of onions, 2 acres of potatoes and 4 acres of pulses (including groundnuts). The gross income of each farmer would have been increased by £70, speculation as to net profit would be pointless. The net imports of these products are valued at approximately £16,000, a sum well worth keeping in the country, but surely not of such a magnitude that any "stimulus" to production would be desirable or even safe when the evils of overproduction in a land locked territory are considered.

13. The only remaining imported crops are wheat (as flour), fresh fruits and coffee. Some importation of flour or wheat will always be necessary both on account of the fact that blending with a certain proportion of foreign wheat is necessary for the production of a good baking flour and also because some further 3,000 acres of irrigable land near the railway line would be required to produce the deficit. It is doubtful if so much new land could be obtained save at the cost of expensive capital works. Moreover, the present milling facilities are inadequate for the total internal demand for flour.

14. A considerable proportion of the fresh fruits imported are deciduous and could not be grown here except on a very small scale and in a few favoured localities. When all the citrus trees in the Protectorate commence bearing the local supply of citrus fruit should be adequate, and when the existing acreage under young coffee comes into bearing the produce would be more than sufficient to supply the local demand.

FARMERS' ASSOCIATIONS.

15. A welcome revival of Farmers' Associations was heralded by the reconstruction of the Mazabuka and District Farmers Association in September. This lead was soon followed by the Chisamba farmers and toward the end of the year steps were being taken to revive the Midland Farmers Association at Lusaka. These representative bodies can be of considerable assistance to the farming community and they are assured of Government interest and support.

16. The locust insurance scheme of the Chisamba Farmers Association is a worthy example of mutual assistance arranged by district farmers in conference. Under this scheme the total losses due to locusts will be shared by the entire district and the possibility of ruin of any individual is rendered remote. The Association is to be congratulated on the possession of a membership which could devise and carry through such a practical co-operative measure.

KAFUE SHOW.

17. In conjunction with the Department of Animal Health the usual agricultural and forestry exhibit was staged at the Kafue Show on July 11th and 12th. The combined exhibit occupied the greater part of a large hall and was generally admitted to be one of the most popular features of the Show.

CROP PRODUCTION.

18. The season 1931-32 was the most favourable one of recent years particularly for grain production. The rainfall was above normal and, what is far more important, was comparatively evenly distributed between an early start and a late termination. With the exception of a dry spell in January, the customary prolonged and exasperating droughts were not experienced during the growing season.

Maize.

19. A record crop was produced on an acreage slightly smaller than that of last year. While the supremacy of Chisamba as a maize producing area remains unchallenged, an average yield of 7.5 bags per acre in the Mazabuka District is at least indicative that in this district the low yields of the two former seasons (4.9 bags and 3.8 bags per acre respectively) were due not to a low standard of farming but to exceedingly unfavourable climatic conditions. Of the total crop, nearly 250 thousand bags were offered for sale.

Maize Pests.

20. There was a slight increase in *Diplodia* damage as might have been expected from the nature of the season. On the whole, however, maize is a remarkably healthy crop in the Protectorate. "Black beetle" and *Helminthosporium* inflict considerable damage where they occur but their range is usually limited to a few farms. The Stalk borer (*Busseola fusca*) as a rule gives little trouble except on farms adjoining native kaffir corn cultivations.

Witchweed.

21. Probably the greatest menace is that presented by Witchweed (*Striga lutea*). The pest has become prominent in the Chisamba district during the last few seasons and a survey of the Lusaka and Mazabuka Districts, conducted during the year, showed that it is of wide distribution both on maize and kaffir corn. A peculiar feature of its distribution is that conclusive evidence of damage could only be obtained from Chisamba where the effects of its parasitism are beyond all doubt. An investigation of alternate hosts showed that the pest is widely distributed on the veld grasses *Digitaria milangiana* and *Setaria sphacelata* in the Lusaka and Mazabuka Districts, while the initial infestation of maize appears to have come from a vlei grass *Setaria phleoides* at Chisamba. The possibility of the existence of two distinct strains of differing virulence is suggested and the matter is being investigated. A trial of trap crops is also being conducted at Chisamba through the courtesy of Mr. H. D. Frost.

MAIZE PRODUCTION.

22.

	Kalomo	Mazabuka	Lusaka	Chisamba	Fort Jameson	Other Districts	Total
		1931-32					
Acres planted ...	1,180	14,446	18,347	7,855	385	544	42,757
Yield in Bags ...	7,730	107,856	100,880	72,872	2,391	4,056	295,685
Yield per acre ...	6.6	7.5	5.5	9.3	6.2	7.5	6.9
		1930-31					
Acres planted ...	1,102	15,673	17,764	7,255	286	894	42,974
Yield in bags ...	5,064	59,155	68,355	55,330	1,974	3,778	193,656
Yield per acre ...	4.6	3.8	3.8	7.6	7.0	4.2	4.5
		Increase (+) or Decrease (-) in 1931-32					
Acres planted ...	+78	-1,227	+583	+600	+99	-350	-217
Yield in bags ...	+2,666	+48,711	+32,525	+17,542	+417	+278	+102,029
Yield per acre ...	+2.0	+3.7	+1.7	+1.7	-0.8	+3.3	+2.4

Green Manuring.

23. The benefits of green manuring are now generally recognised and the practice has extended remarkably during recent years. When the ratio of green manuring conducted in 1930-31 to the maize acreage planted in 1931-32 is compared with the average yield in each district in the latter year, the following figures are obtained :

District				Acres green manured 1930- 31 per 100 acres of maize grown in 1931- 32	Maize yield per acre (bags) 1931-32
Chisamba	...	...	...	38	9.3
Mazabuka	...	...	...	22	7.5
Kalomo	...	...	...	17	6.6
Lusaka	...	...	...	11	5.5

The correlation is an exceedingly high one partly due to the very even distribution of rainfall between the districts concerned. The extent to which green manuring is practised may, within limits, be taken as an index of the general standard of farming, and this in the season under review is strikingly reflected in the yields obtained.

Wheat.

24. The abundant rainfall rendered possible a considerable extension of the area under irrigation wheat. 2,261 acres were planted and the total yield was 11,373 bags, an average of 5 bags per acre. Corresponding figures for the previous season are 1,594 acres, 5,627 bags and 3.6 bags per acre. Slight locust damage occurred on one or two farms. Approximately 10,500 bags were offered for sale.

Groundnuts.

25. The area under groundnuts fell from 1,334 acres to 526 acres and the yield from 8,652 to 3,772 bags. The unpopularity of this crop is largely due to the low price at which groundnuts are obtainable from other territories. Groundnuts certainly cannot be produced for 6s. 6d. per bag unless high yields are obtained, and the average yields during the last two seasons have been but 6.5 and 7.2 bags per acre respectively. The yields at the Mazabuka Station are usually considerably in excess of 15 bags per acre and if these could be obtained more generally the present low labour costs should render profitable cultivation possible even at the low ruling prices.

Tobacco : North-Western Area.

26. Very few farmers produced tobacco in the North-Western districts but excellent crops were obtained by those who did. The desperate situation in the maize and cattle markets has caused a revival of interest in tobacco and several growers recommenced operations during the year. Others are considering a start next season. As tobacco is the one crop which is not ruled out of the export market at the present time, a cautious revival would be welcome particularly among those who already possess the necessary buildings, but the ever changing demands of manufacturers and the sheer impossibility of obtaining a series of uncontradictory reports on Northern Rhodesian tobacco still render the venture more speculative than is desirable.

Tobacco : North-Eastern Area.

27. Fort Jameson enjoyed a good season as far as production is concerned. Rainfall was well distributed and there was little disease. Fifty-four estates were in production. For some few seasons producers of good quality "semi brights" have found a satisfactory local market and many planters had definitely turned their attention to this class of tobacco. Unfortunately, shortly after the opening of the last buying season, a change in the buyers policy resulted in growers being

left with their crop on their hands. Few had sufficient resources to export and for a time tobacco of excellent quality was sold at ruinously low prices whenever the opportunity occurred. Conditions improved slightly toward the end of the season but the mild hopes, engendered last year, of the gradual lifting of the cloud of depression which has overshadowed the district since 1927, were not realised.

28. The scheme of government assistance was confined to five growers and has now been discontinued. The grading and packing of the collective crop was supervised by the Tobacco Adviser and the satisfactory quality of the exported grades is largely due to the care with which he performed this work.

VIRGINIA TOBACCO PRODUCTION.

29.

				N.W. Districts	N.E. Districts	Total
				1931-32		
Acres planted	...	...	...	128	2,344	2,472
Yield in lbs.	...	...	...	79,000	1,106,415	1,185,415
Yield per acre	...	...	...	617	472	480
				1930-31		
Acres planted	...	...	...	252	2,076	2,328
Yield in lbs.	...	...	...	108,159	843,100	951,259
Yield per acre	...	...	...	430	406	409
				Increase (+) and Decrease (-) in 1931-32.		
Acres planted	...	...	...	-124	+268	+144
Yield in lbs.	...	...	...	-29,159	+263,315	+234,156
Yield per acre	...	...	...	+187	+66	+71

Coffee.

30. Little extension of coffee plantations has occurred during the year and two older estates have been abandoned. The majority of the younger plantations will commence bearing next year, and planters are wisely refraining from extensive planting until the prospects of the industry are more definite. During the year favourable reports on samples of Abercorn coffee have been received from the home market, but it has been said with a certain grim humour this is "a country of wonderful samples." Be that as it may, there is little doubt that the quality of the Abercorn coffee is definitely high and if only the taste or, more particularly, the *cuisine* of consumers could be educated up to it, a substantial market could be established locally.

Coffee Pests.

31. Apart from the white borer (*Anthores leuconotus*) few pests trouble the Abercorn planters at present. Cutworms and Green Scale are fairly prevalent but are readily controlled by cutworm collars and spraying respectively. While not yet recorded at Abercorn, *Antestia* is a serious pest in neighbouring territories and has practically ruined an abandoned estate at Serenje. The possibility of its introduction to the district together with the danger of unrestricted breeding on abandoned estates, has been brought to the notice of the Abercorn Planters' Association. It is understood that this body will shortly request that appropriate regulations be published under the Plant Pests and Diseases Ordinance.

32. The necessity for some form of cover crop during the long dry season is becoming apparent and high winds have rendered shelter belts essential. *Cupressus* seems to be the most promising of the exotics for this latter purpose at high elevations while *Cassia siamea* and *Grevillia robusta* do well below 4,000 ft. Pending the formation of adequate shelter belts, grass fences have been a necessity in the more exposed portions of plantations.

EXPERIMENTAL STATIONS.

33. The approved programmes were continued at the three experimental stations. One notable extension of the work at Mazabuka was the commencement of systematic pasture investigations which are discussed in some detail in later paragraphs. Following the practice of last year, detailed accounts of experimental work are omitted from this report as the inauguration of the Annual Bulletin has afforded a more convenient medium for their publication.

THE MAZABUKA STATION.

34. The absence of an abnormally large number of officers on leave and the necessity for the detachment of some of the remainder for locust duty, created rather a difficult situation at the Mazabuka Research Station. It was nevertheless possible to carry through the major portion of the programme.

Maize.

35. Evidence from an extended series of Maize variety trials is somewhat conflicting but it appears that under local conditions "Salisbury White" is slightly more prolific than "Hickory King." "Anveld" proved definitely inferior of either of these two popular varieties. No conclusive result has been obtained from a comparison of "Hickory King" and "Potchefstroom Pearl." In 1927 the station supply of "Hickory King" was obtained from a prominent local grower. Since then no selection other than for freedom from disease and uniformity of grain has been practised. A trial of "Station Hickory King" *v.* "Hickory King" obtained from the same grower in 1931, showed that the two were to all intents and purposes identical in performance and appearance. The result is of some interest as it indicates that a farmer who obtains seed maize of this variety from a reputable source and who observes the obvious precautions in selecting subsequent seed, need fear no deterioration of the variety nor is success likely to attend selection for improved yields.

Velvet Beans.

36. A trial of six varieties of velvet beans showed conclusively that "White Seeded Stingless," which is that most commonly grown in the settled area, is inferior to "Georgia" as a green manure and to "White Seeded Climbing" as a hay crop.

Sunnhemp.

37. No difference could be observed between the growth of sunnhemp broadcast on scuffled land and that from a seed bed prepared in the normal manner. The matter has not yet been followed to its logical conclusion but it appears probable that no advantage is gained by giving this green manure crop more than the scantiest of preliminary cultivations.

Pastures.

38. In 1930 a large collection of indigenous grasses was made as a preliminary to a programme of pasture work. The various species were grown in pure culture at Mazabuka and their characteristics studied. During the past year the work of the Ecologist has materially aided the foundation of a pasture programme on which a start has already been made.

39. A comprehensive series of pasture management trials has been in progress in Southern Rhodesia for some three years and as the result of these trials will, in all probability, be applicable to this Territory it was decided to approach the problem of veld improvement from a somewhat different aspect. As a preliminary, a survey of the existing pastures in relation to soil types was necessary. This was undertaken by the Ecological Survey and the report has been published in the Second Annual Bulletin of the Department. Five grassland types have been described and their more valuable characteristic species determined. Indication of the succession of species in each type under grazing conditions has been given and the succession in abandoned lands on the "Sweet Bush" and "Plateau Bush" types has also been established.

40. It has been observed that under heavy grazing there is a tendency for the tall grasses to die out quicker than "bottom grasses" come in, with a result that heavily grazed areas rapidly become patchy and weedy. An attempt is therefore being made to ascertain if some of the better grasses can be introduced into tall grass veld by scuffling and seeding. A similar experiment is being conducted with a view to securing the colonisation of over grazed veld by the better species.

41. The indigenous species which seem to merit special investigation are as follows :

Herringbone grass	(<i>Urochloa pullulans</i>).
Rhodes grass	(<i>Chloris gayana</i>).
Sheep grass	(<i>Brachiaria dictyoneura</i>).
Pemba grass	(<i>Brachiaria sp. nov.</i>).
Close finger grass	(<i>Digitaria gazensis</i>).

The utility of imported Rhodes grass is being compared with that of the indigenous variety which is abundant on the margins of the Kafue Flats. As imported seed is expensive the performance of the indigenous variety under cultivation is a matter of considerable importance.

42. The seasonal changes in pasture composition are being assessed by the Chemist and similar work is in progress on each of the more promising individual species. Preliminary observations indicate the exceptionally high crude protein content of Herringbone grass (*Urochloa pullulans*) as compared with that of other indigenous grasses, especially during the winter.

Tobacco.

43. The retrenchment of the Tobacco Adviser has necessitated the cessation of tobacco work. Seed of certain selections and hybrids bred at Mazabuka has been sent to the Fort Jameson station for trial.

Cotton.

44. Recent work on this crop, in which the Entomologist has co-operated with the officer employed by the Empire Cotton Growing Corporation, has largely been devoted to an investigation of the two major insect pests (Bollworm and Stainer) of cotton in Northern Rhodesia.

Cotton Stainers.

45. Seasonal distribution studies of the Stainer over the last three years have shown that three species are concerned in the transmission of internal bollrot, namely, *Dysdercus supersticiosus*, *Dysdercus fasciatus*, *Dysdercus intermedius*, and to a lesser extent the Pentatomid, *Callidea dregei*. The results obtained show that *D. supersticiosus* appears first in the field when flowering commences and is responsible for the staining of the early crop, while *D. fasciatus* appears later and causes the large amount of staining found in the late crop. *D. intermedius* and *Callidea dregei* do not appear to be important factors in the transmission of internal bollrot and their distribution has not been studied in the same detail. Attempts have been made in the past two years to ascertain the extent of damage caused by the Stainer. The amount of stained cotton varied considerably from 62.4 per cent. of the mature crop in 1931 to 35.4 per cent. in 1932.

Their Alternate Hosts.

46. A search for wild host plants which are capable of carrying a stainer population during the inter-crop period has been made. It has been found, so far as the present observations go, that the Baobab (*Adansonia digitata*) and *Thespesia rogersii* are the only two important species in the farming area on the railway line, while of these *Thespesia* predominates. The normal annual host plants appear to be *Hibiscus* spp. of which by far the most abundant is *H. cannabinus*. In the season 1932 this species occurred in pure stand over large areas and on it *D. supersticiosus* was found in large numbers from January to June. It may be that *Hibiscus* is more attractive to *D. supersticiosus* than is cotton, for in this season the species was very much less numerous on cotton and the staining of the early crop was less than in the previous year.

Stainer Control.

47. Control of the Stainer by means of cotton seed traps, handpicking and a combination of these two methods has been investigated over a period of three years. It has been established that none is of practical value. During the examination of these methods it was found in several instances, in spite of the removal of large numbers of stainers (170,000 from one acre in one case), that this had not succeeded in reducing staining below that on an area where the population had remained undisturbed. On further investigation it appeared that well developed bushy plants had always suffered more staining than the less luxuriant types. This question was studied in some detail on a suitable area in conjunction with a survey of soil conditions by the Chemist. The results showed that the more fertile the soil the better was the development of the plant and the larger the initial crop set, but also that this larger crop was more than offset by the greater amount of damage caused by stainer on the bigger plants. The figures obtained for stainer damage were 26 per cent. of the mature crop on the poorer and 53 per cent. on the more fertile soil. The reasons for this difference have not yet been ascertained, but work is at present in progress on the subject.

Bollworms.

48. Two species of Bollworms have been observed, the American Bollworm (*Chloridea obsoleta*), and the Spiny Bollworm (*Earias insulana*). The American Bollworm is mainly responsible for the loss of crop. Seasonal distribution studies have shown that the maximum population of American Bollworm occurs in March and April, but varies in intensity from year to year. The extent of the damage caused by this pest was studied in 1931 and it was found that of the original crop set, some 54 per cent. was attacked by bollworm and shed while 1 per cent. of the mature crop was damaged.

Time of Planting.

49. From evidence obtained in 1930, it was thought that by later planting or the use of a later maturing strain it might be possible to evade the bollworm attack. In view of this a time of planting experiment has been conducted during the past two years, but the results show conclusively that planting should be carried out as early as possible. Although later plantings suffered less from bollworm attack, the decrease in damage is more than balanced by the fact that these set very much less crop than the earlier plantings. In order to supplement the information obtained from this experiment, trials of variously maturing strains have also been undertaken. These show that medium-early maturing strains are superior. An unexpected result was the failure of a very early strain, which was found to be due to the fact that it carried a very large proportion of its crop during the peak of the early stainer attack.

Cotton Prospects.

50. The present position with regard to commercial production of cotton is still uncertain. In the past few years yields of lint have been obtained at the Research Station which would have rendered cotton cultivation remunerative had the Liverpool price been in the neighbourhood of 8d. to 9d. per lb. It must, however, be remembered that in spite of these yields much further information is required regarding the two major insect pests before reasonable assurances of heavy crops can be given. The secondary advantages of cotton as a rotation and fodder crop need no stress.

Food Production.

51. The growing demands for foodstuffs by the Department of Animal Health necessitated some reorganisation of the farm lands and the new arrangement has justified itself, both as an economy and a convenience. Exclusive of interest charges and European supervision but including depreciation of implements, maize was produced at the low cost of 4s. 5d. per bag. This figure must be regarded as an exceptionally satisfactory one in view of the fact that the area involved was but 100 acres. It should be stated that the land was in exceptionally good heart and that owing to the favourable season an average yield of almost 11 bags per acre was obtained. The corresponding cost per bag of groundnuts was 4s. 5½d., based on an area of 20 acres and an average yield of 16.8 bags per acre. The exceptional rains, while favourable to the growth of most crops, were disastrous both for haymaking and for the fruiting of cattle melons.

Farmers Day.

52. Partly as an economy and partly because of the locust situation "Farmers Day" was suspended. During the past two years this had established itself as an enjoyable and well attended function and it is regretted that it will probably be impossible to continue it as an annual event for some time. An increase in the number of individual farmer's visits is recorded with pleasure.

THE ABERCORN STATION.

53. The work at Abercorn, which is a one man station, was somewhat hampered by the extended absence of the District Agricultural Officer in connection with the locust invasion.

Coffee Irrigation.

54. It is becoming increasingly apparent that irrigation is necessary for coffee at Abercorn and during the year under review observations have led to a radical change in practice. Formerly irrigation was delayed until July and

then continued until the onset of the rains, but it now appears desirable to apply water in April, May and June, allowing a rest during the months of July and August when the trees are comparatively dormant, and recommencing in September. It is thought that in this way forced flowering and over-bearing will be avoided and that the water will be applied when it is most needed.

55. The irrigation system introduced by the District Agricultural Officer, and which was described in the report for 1930, has now been adopted by all planters. Under this system the rows of coffee plants roughly follow the contours. A small bund is thrown up on the lower side of each row some 3 feet away from the plants. Irrigation is easily and efficiently carried out, the whole area between the bunds is flooded and there is no run-off. The root system is not restricted as it tends to be with "saucer" irrigation and it is found that most weed growth is concentrated along the bunds where it is easily dealt with.

White Borer.

56. The white stem borer (*Anthores leuconotus*) continues to be the most troublesome pest. The Entomologist has drawn up a scheme of observation work which is now being carried out both in cages and in the field.

The "Chitemene" System.

57. The observation plots established some 30 miles from Abercorn to investigate the "Chitemene" system, have been continued. The results obtained have been published in the Second Annual Bulletin but in view of their importance will be briefly summarised here. *On the poor sandy soils of the plateau there seems little doubt that the heaviest and most reliable yields of "Male" (Eleusine coracana) are obtained under the "Chitemene" system*, moreover this system is undoubtedly suited to the temperament of the native cultivator. Were it not for the fact that the establishment of native reserves has placed a limit on the number of trees available for lopping, it is doubtful if intervention would be either necessary or desirable, but unfortunately there are areas where lopping is giving place to the cutting of whole trees and where the serious consequences of deforestation of river banks and headwaters is already becoming apparent. In the course of time, in some reserves at least, a change will be forced upon the native population by sheer lack of trees, but long before this stage is reached the countryside will have been ruined almost irreparably.

58. For some years the District Agricultural Officer has experimented in alternative methods of "Male" cultivation but no method has given results of any promise excepting an adaptation of the fallow system as practised by the Mambwe people. Contrary to expectations satisfactory yields have been obtained on typical "Chitemene" soils by this system and the department is now in a position to commence exploratory extension work as soon as facilities are rendered available.

59. The transfer of the headquarters of the agricultural officer to No. 5 (Nsokolo) Native Reserve has been approved but the move has been held in abeyance for the time being on financial grounds. No serious extension work aimed at effecting a radical change in traditional practice can be commenced prior to this transfer. In the meantime efforts to induce native farmers to make use of their abundant irrigation possibilities and to cultivate a larger variety of crops and vegetables have been successful.

THE FORT JAMESON STATION.

60. The completion of the buildings at the Fort Jameson Station rendered possible the commencement of the full programme of experimental work outlined in the last report. During the year the tobacco programme was discussed in detail with the local Planters Association and a few minor modifications were adopted on the advice of that body. Repeated visits by local planters are recorded with pleasure.

Tobacco.

61. As was anticipated, restricted barn accommodation rendered the curing of variety trials extremely difficult. Indeed it would appear that such trials at the station can never be regarded as more than indicative, but they will at least serve a useful purpose in saving planters the trouble and expense of eliminating

unsatisfactory varieties by farm trials. In the "Bright" trials "White Stem Orinoco" and "Hickory Pryor" were markedly superior to "Gold Leaf." There was little to choose between the two former varieties. "White Stem Orinoco" gave slightly the heavier yield but "Hickory Pryor" cured better. Of the "Semi Brights" "Cash" was markedly superior to "Adcock" or "Warne."

62. In all $11\frac{1}{2}$ acres of tobacco were grown at an average yield of 800 lbs. cured leaf per acre. It is gratifying to record the receipt of an offer of 10d. per lb. for the entire crop unpacked at the farm. The volume of work involved in the separate harvesting and curing of numerous small experimental plots of different varieties and treatments was very considerable and the results reflect the greatest credit on the District Agricultural Officer who, incidentally, had never cured a crop of tobacco before. His task was lightened by the valuable help of the Tobacco Adviser when the latter was not engaged on work in connection with the Government assistance scheme.

Maize and Groundnuts.

63. Maize variety trials again indicated the superiority of "Salisbury White" and "Hickory King" over the native type, and native groundnuts appear definitely inferior to the "Spanish Bunch" and "Virginia Runner" varieties. "Hickory King" maize seed has been issued for trial to a few selected native farmers.

Cotton.

64. For the past two years cotton has given most satisfactory yields. Boll-worm damage has been negligible and the stainer has been the only serious pest. During the year under review "U4" gave an average yield of 603 lbs. seed cotton per acre on virgin land while a Mazabuka selection from "U.4/4" yielded 721 lbs. per acre on older and better cultivated soil. Unfortunately the prospect of continued low prices for cotton render its profitable cultivation at Fort Jameson improbable for many years and the trials will be discontinued.

FORESTRY.

65. After three years of unspectacular but essential spadework the foundations of a forestry service are now firmly laid. As a result of extended reconnaissances and laborious compilation of data, the forestry branch is now in a position to answer most enquiries regarding our timber resources both as to the distribution of species and their characteristics. The next stage, investigations into the utilisation of the more promising species, has already been commenced at Ndola. The full report of the Senior Assistant Conservator is published as an appendix to this report.

AGRICULTURAL EDUCATION.

66. The Agricultural School at Mazabuka continued in operation until June when a final examination was held and the school closed. Of the eight pupils who completed the course, six passed and were offered employment. Of these one became an agricultural instructor at the Barotse National School and the remaining five were absorbed by the department as native assistants. It would be premature at this stage to assess the value of their training, but it seems probable that centralised and formal instruction in an agricultural school at present an unnecessarily elaborate and expensive method of training youths for service in the department.

67. The original aim of the school was the training of agricultural "demonstrators" for extension work among native farmers. There is undoubtedly considerable scope for such work, even though in most districts efforts to improve native agriculture would perforce be confined to the improvement of dietary, but it is considered premature to train and employ large numbers of "demonstrators" until adequate arrangements for the direction and supervision of their work exist.

EXTENSION WORK.

68. Recognition of the necessity for caution in extension work among native farmers is still far from general. There are few matters in which it is more imperative to proceed warily. No attempt should be made to induce changes in systems of native agriculture until the soundness of the "improvement" is abundantly proved *under the conditions in which the native farmer himself works.*

The present facilities for extension work among natives are very limited and the financial situation is unlikely to permit of any expansion in the immediate future. Progress will therefore be slow until the number of agricultural stations in native areas can be increased, for it is better to attempt nothing than to institute extension work which cannot be supervised and which is based on theory rather than practice.

69. In the meantime collections of native crops have been made and studied at Mazabuka and Abercorn and a detailed survey of native agricultural methods is being made in conjunction with the Ecological Survey. As soon as circumstances permit, a commencement of extension work in native areas will be made and it is believed that this will be materially assisted by the spade work which has preceded it.

THE AGRICULTURAL SURVEY.

70. The Agricultural Survey of the railway belt was completed in May and work was then suspended. The report of the survey party, which has now been published, gives details of all farms on unalienated land together with opinions of their suitability to various branches of agriculture. The value of such a list to Government and to intending settlers is considerable despite the fact that, as predicted in last year's report, the greater part of the best arable land has already been taken up. While further settlement of farmers on any appreciable scale must await an increase in the consuming population or a decided improvement in the export markets, Government is now in possession of the facts and can proceed with the alienation of land as the necessity for such action arises.

Aerial Co-operation.

71. For three months in 1931, Captain Robbins of the Aircraft Operating Company, was attached to the survey party to demonstrate the extent to which aerial photography can be employed in vegetational surveys. His report and maps afford indisputable evidence of the value of aerial co-operation with a ground survey as a means of assessing the agricultural potentialities and particularly the forestry resources of a territory.

ECOLOGICAL SURVEY.

72. The direct application of ecological surveys to Agriculture and Forestry is a recent development and an extensive trial of the method is being undertaken for the first time in this Territory. It is held that the natural vegetation cover is the most efficient indicator of soil type and fertility and therefore that a rapid means of land classification for agricultural, pastoral and forestry utilisation can be obtained through skilled investigation of the natural flora in relation to its environment. The utility of the method has been fully demonstrated in the course of the surveys undertaken during the year.

73. The survey was inaugurated by Professor Adamson of Cape Town University in June. The area first covered was that portion of the Kafue Basin within the Lusaka, Mumbwa, Namwala, Kalomo and Mazabuka Districts. The traverses necessary for the investigation of 10,000 square miles of country thus defined were carried out between June and October and a report is in course of preparation. This survey was largely concerned with the native areas in contact with the European farming belt. Both density of native population and agricultural practice were found to be closely correlated with bush type. It was found that where the native did not aspire to production of maize on a large scale he preferred a type of country differing in character from that normally selected by the European farmer. There is a tendency, however, for the natives near the railway line to develop into small producers and here the land requirements of natives and Europeans approximate to one another. Considerable attention is being paid to the possibility of developing crops and forest products which can be produced on the type of land traditionally selected by native farmers.

74. A more detailed survey of the Mwembeshi irrigation project was undertaken in conjunction with the agricultural Chemist and a separate report on this area has been submitted.

75. On account of its urgency, a detailed survey of the pastoral regions bordering the railway line was included in the first year's programme. A comprehensive account of this work has been published in the departmental Annual Bulletin and its bearing on the pasture investigations is discussed elsewhere in this report.

ANNUAL BULLETIN.

76. *The Second Annual Bulletin* of the Department went to press during the year though it was not published until early in 1933. The diverse nature of the contents gives an indication of the investigations which have been undertaken and which have proceeded sufficiently far to render the publication of results desirable :

- "The Grassland Types of the Central Pastoral Region of Northern Rhodesia."
- "Notes on Fertiliser Trials, 1928-32."
- "Fruit Culture in Northern Rhodesia."
- "The Movement and Breeding of Locust Swarms (July, 1931-September, 1932)."
- "Some Indigenous Crops of Northern Rhodesia."
- "Witchweed."
- "Native Agriculture in Abercorn District."
- "A Trial of Six Varieties of Velvet Beans."
- "Farmyard Manure : An Experiment."
- "The Mukushi Forests of Northern Rhodesia."

The publication is sold within the Territory at 1s. per copy post free and elsewhere at 2s. 6d. The number of local purchases of the 1931 Annual Bulletin was somewhat disappointing, not, it is thought, due to lack of interest but because the purchase and despatch of small postal orders are matters which are apt to be overlooked. Through the courtesy of the Postmaster-General the Annual Bulletin will in future be on sale at Post Offices.

THE LOCUST INVASION.

77. In order to get a complete picture of the locust situation in 1932, it is necessary to recapitulate the course of the 1931 invasion.

The Migratory Locust.

78. The Abercorn District was invaded by swarms of Migratory Locusts (*Locusta migratoria migratorioides*) from Tanganyika Territory in July, 1931, and the invasion continued until the end of August. The main avenue of flight into Northern Rhodesia was east of Lake Tanganyika and, after crossing the border, the swarms proceeded in a westerly direction through the Abercorn and Mporokoso Districts with a slightly more southerly trend through the Mweru-Luapula Province. The continuation of this west to south-westerly movement through the Congo Belge was followed by the invasion of the northern portion of the Kasempa Province and by the passage of swarms into Angola. Thence a more southerly movement resulted in the appearance of swarms in the Balovale and Kalabo Districts of Barotseland during October. This first phase of the invasion resulted in egg-laying in western Barotseland to some extent in the Kasempa Province, but swarms which remained in the Abercorn District tended to break up and to move north across the border. In October, 1931, the latter district was free from locusts.

79. Renewed invasion of the Abercorn District occurred on a more extensive scale during November and December and the swarms passed through the Kasama, Luwingu and Mpika Districts and extended as far south as the Serenje District. Egg-laying occurred almost immediately and by February, 1932, most portions of the Tanganyika and Awemba Provinces were infested by hoppers. Hopper emergence in the Bangweulu Swamp areas was slight probably on account of extensive flooding of egg deposits.

80. The first daughter swarms bred in Barotseland became winged in January but elsewhere the flying stage was not generally attained until March. No second generation was recorded. A renewed invasion by young flying swarms from Tanganyika Territory commenced in March and continued until August. These swarms flew somewhat further south than during the previous invasions. Both the invading swarms and those bred locally continued to migrate in a general west-south-westerly direction and toward the end of the winter it is thought that few remained in the Territory.

81. Unfortunately in October it became evident that a southerly movement of swarms had occurred in territories to the east and Northern Rhodesia was menaced at all points along its north-eastern, eastern and south-eastern borders. An invasion of the East Luangwa and Kafue Provinces commenced from Portuguese

East Africa and a few more swarms entered the Abercorn District from Tanganyika Territory. Some egg-laying occurred in the north-east and in the Luangwa and Kafue Provinces. In general, however, Migratory Locust activity toward the end of 1932 was completely over-shadowed by the development in the Red Locust situation.

The Red Locust.

82. Red Locust activity commenced in the Mweru Marsh area in August, 1931, and in October many swarms moved into the Kawambwa and Fort Rosebery Districts. The subsequent flight course of this species was strikingly similar to that of 1930 but on a vastly greater scale. In November, 1931, the Mweru-Luapula Province was heavily infested. A south-westerly movement from Lake Mweru and adjacent areas in the Congo also resulted in the invasion of the Kasempa Province and the Mankoya and Sesheke Districts of the Barotse Province. Some swarms crossed the Zambezi and entered the "Caprivi Strip." Extensive egg-laying occurred in all invaded districts and by January, hoppers had emerged in vast numbers. Isolated breeding also occurred on the Kafue Flats in the Mumbwa District.

83. In April, 1932, all hopper swarms reached the winged stage. There was a movement towards the Mweru Marsh region by swarms in the northern part of the Territory. Some swarms flew south or south-west from the Sesheke District and the remainder apparently vanished into the sparsely inhabited portions of the Kasempa and Barotse Provinces.

84. The Red Locust remained quiescent from July until the end of September. In October swarms became active in the Mweru-Luapula Province and there was a general southerly movement accompanied by some influx from the Congo across the northern border. At the end of the month large swarms entered the Abercorn District from Tanganyika Territory. During November invasion from Tanganyika Territory continued in a general south-westerly direction, resulting in the invasion of the Awemba Province. Southward movement through the Mweru-Luapula Province continued into Serenje and Ndola Districts and swarms from the Congo entered the Kasempa Province. A southerly to south-westerly movement through the Mumbwa and Namwala Districts took place, probably originating from breeding in eastern Barotseland. In December no definite migratory tendencies could be traced. Vast numbers of swarms were present moving in all directions. Consequently the invasion spread to almost every district and egg-laying took place on a hitherto unprecedented scale. Hopper emergence commenced toward the end of the year. For the first time the farming areas on the railway line have been directly threatened and some loss of crops will be inevitable.

Locust Campaign.

85. The locust campaign, inaugurated late in 1931, was continued with unabated vigour until February, 1932. It was found that the use of poison in the form of powder was both inconvenient and expensive and, where facilities existed, poison spray was used with a much greater measure of success. Vast numbers of swarms were destroyed during the course of the campaign but it became increasingly evident that not only would a policy of complete extermination prove extremely expensive and almost impracticable, but that even if complete success were attained the Territory would nevertheless be overrun by flying swarms bred elsewhere. At the end of February, therefore, the campaign was terminated and as much attention as possible was paid to the protection of native gardens.

86. Approximately £10,000 was spent on locust control during the financial year 1931-32, but unexpended stores to the value of about £3,000 remained available for subsequent operations. Although abandoned before completion, the campaign was by no means wasted. In heavily infested areas, particularly those in the Tanganyika Province, the determined efforts to exterminate swarms won the confidence of the native and the subsequent measures taken to protect gardens received his full co-operation. An abundant harvest was reaped and locust damage was largely confined to a portion of the "Male" (*Eleusine coracana*) crop which was taken by flying swarms in March and April. In no district was there any approach to famine conditions.

Entomological Work.

87. The Entomologist was on leave in the early part of 1932 but on his return proceeded to the Serenje District where detailed observations on the behaviour of swarms of the migratory locust were made. Correlation of swarm movement with meteorological observations by means of "bio-climatographs" has enabled the movement of this species to be forecasted in the Protectorate with some considerable degree of accuracy.

Policy, 1932-33.

88. The locust policy for 1932-33 was virtually dictated by the financial position. Moreover it was obvious from the experience of the former year that the very widespread distribution of Red locust would render impossible the extermination of more than a fraction of the swarms even if unlimited funds were available for this purpose. Thus a policy of complete extermination would have resulted in serious financial embarrassment to Government while affording no appreciable degree of security either to ourselves or to our neighbours. This view has since received striking confirmation in a survey of the locust outbreak in Africa and Western Asia, 1925-31, prepared for the Locust Control Committee of the Economic Advisory Council by Mr. B. P. Uvarov. The following is an extract :

"Thus the chief and very bitter lesson of the last few years has been the realisation that in tropical and sub-tropical Africa and Asia it is impossible however great efforts are made, to control an outbreak of locusts once the invasion has been allowed to spread over large areas.

It is often suggested that the lack of final success in locust control is due to the inadequacy, or even absence, of control organisations in some countries, which, therefore, supply locusts to their unfortunate neighbours. This may be so to some extent with regard to such countries as Abyssinia and Arabia, but there is every reason to think that even the introduction of modern methods and of an efficient organisation of control in all the infested countries would be unable to affect materially either the general development or the extent of locust outbreaks. Indeed, to be really effective, the anti-locust campaigns would have to be organised over a territory comprising a quarter of the African continent and a large part of South-Western Asia, on a scale so gigantic as to verge on absurdity."

89. It was therefore decided to undertake no locust campaign. Administrative officers were requested to do all in their power to encourage and assist natives in the protection of their crops. Locust poison was rendered available to settlers at the reduced rate of 7s. 6d. per case and the Entomologist was instructed to tour the settled area continuously to advise farmers in the making of preparations to combat the inevitable hopper attacks.

Crop Protection.

90. The protection of crops from hopper swarms is a comparatively simple operation and, provided that adequate labour and equipment are available and that preparations are made in advance, complete success should be assured, though repeated attacks may render defensive measures somewhat expensive. The warding off of flying swarms is in a different category, for where locusts are determined to alight it is doubtful if anything will thwart them. The conflict in reports on the efficacy of smudge fires is doubtless explained by the fact that smoke is definitely a deterrent to swarms seeking rest by day in the course of prolonged flight but it is useless against swarms settling for the night. As, however, the production of smoke and, to a lesser extent, of noise is all that can be done to ward off flying swarms, these simple precautions should not be neglected.

Chemical Smoke Mixtures.

91. A form of chemical smudge which had been recommended elsewhere was found on investigation to be too expensive and, after repeated experiments, the following formula was devised :

Coal Tar	...	...	...	...	7 parts by weight.
Nitrate of Soda	...	...	...	9	" " "
Sulphur	...	...	...	5	" " "
Borax	...	...	...	2½	" " "

This mixture when primed with a little nitrate of soda was ignited readily by a blow lamp or fuse igniter and in partially covered tins evolved large volumes of acrid smoke. Although much cheaper than the original, the use of this smudge is hardly a practical measure for the protection of large areas and at the best it should be regarded as an accessory to slow grass or brushwood fires.

WATERBORING.

92. Waterboring operations were conducted throughout the year but on a restricted scale. Owing to a decrease in the number of private applications and in government work two plants were closed down in February. The third plant was employed throughout the year. The average depth of farm boreholes was 126.5 feet as compared with 93 feet in 1931.

93. *Waterboring Statistics, year ending 31st December, 1932 :*

Details.	Boring for Farmers and Associations (Sliding Scale from £5 to £2 10s. per day).	For Government Departments (Special Charges).	Totals.
Number of applications received ...	19	7	26
Number of applications cancelled ...	7	—	7
Number of boreholes completed ...	11	7	18
Number of boreholes standing over	1	—	1
Total number of feet bored ...	1,291	1,146	2,437
Average depth of boreholes in feet...	126.5	164	—
Average cost of boreholes per foot ...	6s. 4d.	No charge	—
Average length of casing used in feet per borehole	50.7	25	—
Cost of 6" casing per ft.	5s. 6d.	5s. 6d.	—
Cost of 7" casing per ft.	8s. 1d.	8s. 1d.	—
Total quantity of water obtained per day (gallons)	148,250	211,500	359,750
Greatest quantity of water for one borehole per day	40,000	120,000	—
Least quantity of water for one borehole per day	350	2,160	—
Number of boreholes with no water	1	1	2

MAZABUKA,
10th May, 1933.

C. J. LEWIN,
Acting Secretary for Agriculture.

ANNUAL REPORT OF THE FORESTRY BRANCH FOR THE YEAR 1932.

INTRODUCTION.

1. Reductions in estimated forestry expenditure necessitated a restriction in planting and sowing operations but, in spite of adverse financial conditions, considerable progress can be reported by the Forestry Branch in respect of the fourth year of its activities.

2. It is recorded with regret that, on account of the severe depression experienced on the Copper Belt, the Roan Antelope Copper Mines, Ltd., the Mufulira Copper Mines, Ltd., and the Rhodesian Selection Trust, Ltd., have discontinued their afforestation experiments. Through the courtesy of the General Manager of the Roan Antelope Mine, however, the Forestry Branch was enabled to take over a series of experiments in the afforestation of dambo soils. The maintenance of these young plantations will eventually give positive or negative results of great value to the Territory.

3. Afforestation with exotic species in Northern Rhodesia presents many difficulties especially in the region with an average annual rainfall of less than 40 inches and it is realised that a greater dependence will have to be placed on indigenous species and the improvement of natural forests and woodlands in order to satisfy future demands for timber and fuel in the drier localities. Trial plantings of indigenous species have already demonstrated their superiority by the facility with which plantations can be established by spot sowings and by the higher rate of survival under exacting conditions.

4. It must not be inferred that indigenous species are capable of supplying all the timber requirements of the Territory. Softwoods constitute the bulk of imported timber and the continuance of their use depends on whether or not equally efficient timbers can be grown locally at a lower cost. The substitution of indigenous material is certainly feasible in many of the uses to which imported softwoods are put, but exotic species will have to be grown to compete in those classes where lightness as well as durability are essential. It is already apparent that the most suitable region in the Territory for the establishment of exotic plantations is that embraced by the Northern Division. The extent to which the planting of selected exotics can be carried out in this Division is, at the moment, an indefinite matter, but once proved successful and economical it should lead to large scale operations. In view of the foregoing remarks the value of the new Forest Divisional Station at Ndola, to which later reference is made, will be readily appreciated.

5. During the past four years a survey of the forest resources of the Territory has been carried out as far as available funds and technical staff have allowed. While the collection of detailed and accurate data in connection with forest growth over such a vast country has, by reason of these circumstances, been confined to comparatively small areas, it has now become possible to concentrate attention on those regions which deserve the earliest attention in forest development. During the year under review progress has been made in the reservation of woodland tracts and many other areas have been examined with a view to their eventual demarcation.

6. The writer has estimated that there are approximately 176,000 square miles of woodland in Northern Rhodesia of which 54 per cent. is the property of the State, excluding Native Reserves. Some 32,000 square miles or 33 per cent. of the State woodlands are so situated as to warrant protection in the interests of regulation of water supply, the prevention of erosion and the production of a certain amount of timber and fuel for local consumption. A further 2,800 square miles or 3 per cent. of the State woodlands are worthy of development and management for the production of commercial timber.

7. It is estimated that the native population of the Territory annually consumes approximately 160,000,000 cubic feet of timber and fuel including the amount destroyed by the practice of shifting cultivation. While a certain amount of the fuel is derived from dead wood, it has been observed that such dry wood is largely caused by the uncontrolled fires which originate in native gardens. The concentration of natives into Native Reserves has resulted in considerable increases in the population per square mile, and in those Reserves where shifting cultivation

is practised there is a very marked danger of rapid exhaustion of the forest capital unless adequate protection and afforestation measures are undertaken. The Branch is studying this problem, but a great deal of work remains to be done before satisfactory and economical measures can be devised. It is apparent however that considerable co-operation will be necessary between forest officers and the Native Authorities through the Administration.

8. A paper on "The Mukushi Forests (*Baikiaea plurijuga* Harms.) of Northern Rhodesia" by the Assistant Conservator, Western Division, has been published in *The Annual Bulletin* of the Department of Agriculture, 1932. The Mukushi is the principal tree exploited commercially in the Territory and the operations at Bombwe Forest will have far reaching effects in the future development of the valuable forests of the Kalahari Sands.

ESTABLISHMENT.

9. The Senior Assistant Conservator returned from vacation leave on 9th April. Mr. R. G. Miller, Assistant Conservator, arrived in the Territory on first appointment on 27th September.

10. At the end of the year the staff of the Forest Branch consisted of the Senior Assistant Conservator, three Assistant Conservators, one Native Clerk and six Forest Guards.

11. Until it is possible to offer a higher rate of wage, the existing difficulty of recruitment of a satisfactory type of Forest Guard will prevail. Seven Guards were discharged during the year and one Guard resigned.

ORGANISATION.

12. A new Forest Divisional Station was opened at Ndola on 19th November and Mr. C. E. Duff, Assistant Conservator, was placed in charge. The Northern Division comprises the District of Ndola and the Kasempa Province, a total area of approximately 55,000 square miles, and has for its northern boundary the Zambesi-Congo watershed. The importance of work in connection with the utilisation of native timbers and the demarcation and reservation of timber and protection forests cannot be over-estimated, since this Division enjoys an average rainfall exceeding 45 inches per annum and offers a greater potential return from forest management than any other part of the Territory.

13. Mr. J. D. Martin, Assistant Conservator, was in charge of the Divisional Station at Bombwe Forest throughout the year, with the exception of the period 3rd February to 1st April during which he was seconded to the Locust Destruction Campaign in the Sesheke District. The Western Division includes Barotseland and the Kalahari Sand areas lying to the west of the Batoka Province. Forest legislation does not apply to Barotseland. The area contains valuable forests of *Baikiaea plurijuga*, some of which are under concession to the Zambesi Saw Mills, Ltd.

14. The North-Eastern Forest Division comprises Tanganyika, Mweru-Luapula, Awemba and East Luangwa Provinces together with the Serenje District of the Luangwa Province. Owing to shortage of staff it has not yet been possible to post a Forest Officer to the Division.

15. The Southern Division includes the Batoka and Kafue Provinces and the Districts of Mkushi and Broken Hill. It was proposed to move the headquarters of Forestry Branch from Mazabuka to Lusaka but the matter is now in abeyance.

RECONNAISSANCE OF FOREST AREAS.

Northern Division.

16. A reconnaissance was made of the forest lying North-West of Ndola and proposals for the demarcation of a Reserve in the area are being formulated. The upper part of the Luanshya River Forest Reserve was also inspected and it was observed that the surrounding country is undergoing extensive cultivation by natives.

17. In November the Mavunda type of forest was examined in an area roughly 70 miles south of Mwinilunga. This fair quality high forest carries up to 200 trees per acre, the dominants forming a discontinuous canopy averaging 70 feet in

height. The dominant species include *Brachystegia utilis*, *B. hockii*, *Copaifera coleosperma*, *Cryptosepalum pseudotaxus*, *Erythrophloeum africanum* and *Pterocarpus angolensis*. There are a number of sub-dominant species but the chief characteristic of the Mavunda type is the dense unbroken mass of undergrowth made up of shrubs, creepers and regeneration of all species. The forest floor is in many places covered with mosses; grass is rare and termite mounds are entirely absent. The soil is a sand of uniform texture, varying in colour from grey to pink, and, in all probability, geologically related to the Kalahari sand formations of Barotseland. The economic development of the Mavunda forests is entirely dependent on their future accessibility to any extension of the Nchanga rail-road.

18. The "Braken" sand areas of the Mwinilunga District carry some of the best timber forests in the Territory. These sands are apparently derived from the Upper Sandstones of the Karroo System and in certain localities are crested with Kalahari sands supporting a modified Mavunda type of forest, in fact outliers of Mavunda forest extend right up to the Congo Border. The Bracken sand woodlands reach their best development on gently sloping ground. The principal dominants are *Brachystegia hockii*, *B. utilis*, *Parinarium* spp., *Marquesia* spp., *Erythrophloeum africanum*, *Faurea discolor* and *Isobertinia tomentosa*. *Pterocarpus angolensis* and *Copaifera coleosperma* are thinly scattered in this type. Bracken, together with a thinner growth of grass, covers the soil. In addition to carrying good natural forest the Bracken sands are the most likely type in the region of high rainfall in which plantations of conifers offer prospects of success.

Western Division.

19. The vegetational survey on the Barotse-Namwala Cattle Cordon, carried out during the latter part of last year, was supplemented by a similar survey between Bombwe Forest and Bowwood. The approximate eastern limit of the Kalahari sands has been ascertained and vegetational maps have been prepared.

20. The Mukushi Forests (*Baikiaea plurijuga*) of Sibulu, Muswaswa, Kataba, Chikutulume, Nachitwe, Mutomba and Ngoma were examined and reported on. The aggregate area of these forests approximates 37 square miles and steps are being taken for their reservation.

Southern Division.

21. An area of 348 square miles of woodland, excised by the Agricultural Survey Commission, and lying on both sides of the railway line between Choma and Pemba, was reconnoitred for the purpose of determining its suitability for demarcation as a Protection Reserve. Vertical and oblique photographs obtained from the Aircraft Operating Company and the topographical map of the region prepared by the Aerial Survey proved of the greatest assistance in the work. The area is a well defined watershed forming the headwaters of five rivers, all of which are important either to European or native settlements. Few of the more valuable native timbers occur in the region and conditions are not favourable to afforestation on a large scale. Disturbance of the woodland vegetation, which at present occupies 80 per cent. of the area, has far reaching results, accelerated by the undulating nature of the country and the general absence of a luxuriant ground cover. Shifting cultivation, the increased use of ploughs by natives, and over-grazing have been responsible for a great deal of erosion and in many localities have influenced the drainage channels to such an extent that perennial streams have been reduced during the last twenty-five years to nothing more than a series of pools in the dry season. The cumulative effects of uncontrolled grass burning involve a loss in fertility and render the soil less absorbent of moisture. Adequate protection of the area will necessitate fire control measures and a gradual reduction in the native population and number of cattle by their removal to adjoining native reserves.

22. The future supply of wood fuel for Lusaka constitutes a matter of importance. Preliminary investigation in that locality revealed two areas suitable for reservation and management, and capable of supplying a sustained yield. Further examination of these tracts was carried out with the assistance of aerial photographs and definite proposals were submitted to Government. The recommendations were accepted in respect of the area of 39 square miles to the south of Lusaka but on account of the second area coinciding with part of Native Reserve No. 6 further action thereon was considered undesirable.

23. Progress in the mapping of woodland types between Namwala and the railway line at Mazabuka and Monze and Pemba can be recorded. An officer of the Branch was seconded to the Ecological Survey during a period of their work in this area.

North-Eastern Division.

24. Through the courtesy of an officer of the Department of Animal Health, travelling on local leave, free transport was afforded between Mazabuka and Fort Jameson to an officer of the Branch who was thereby enabled, during the period of one week, to study the vegetation along the Great East Road and also to investigate forest conditions in the Chiparamba Native Reserve.

PROCLAMATION AND DEMARCATION OF FOREST RESERVES.

Luanshya River Area.

25. By Government Notice No. 40 of 1928, this area was gazetted as a Demarcated Forest. It was omitted to state in last year's annual report that, by authority of Government Notice No. 65 of 1931, certain mining areas were deleted from the Reserve. The actual area remaining is 17 square miles. The boundaries as described do not altogether conform with the objects of reservation and early revision is contemplated.

Choma-Pemba Watershed.

26. This area of 348 square miles was gazetted as a Demarcated Forest by Government Notice No. 119 of 1932. No work was carried out in the Reserve during the year under report on account of lack of funds.

Lusaka (South) Fuel Reserve.

27. The area of the Reserve gazetted in Government Notice No. 149 of 1932 is 39 square miles. The Reserve is composed of *Brachystegia-Isobertinia* woodland with irregular stocking. It is anticipated however that a maximum sustained annual yield of 4,000 cords can be obtained under management.

Bombwe Forest.

28. The forest was surveyed and demarcated during the year in preparation for its proclamation as a reserve. The total external boundary is 11.8 miles long and was completed at a cost of 6s. per mile.

PROTECTION OF FORESTS AND PLANTATIONS.

Fires.

29. The customary annual burning of grass throughout the Territory attains such proportions that the complete protection of large areas of Savannah woodland by the formation of systems of fire belts is considered impossible since fires are invariably started within the lines. Intensive methods of this type are expensive and it is probable that a policy of controlled light burning early in the dry season will prove sufficiently effective in eliminating fierce late fires, and will enable young growth to reach the pole stage without serious check.

30. In the *Baikiaea plurijuga* forests of the Kalahari sands the dense undergrowth of shrubs and climbers prevents vigorous grass growth except where this canopy has been opened for extraction and silvicultural purposes. A system of fire belts is essential for the protection of such forests since during the latter part of the dry season the undergrowth itself becomes inflammable. It is recorded with satisfaction that the fire protection measures carried out at Bombwe Forest were attended with complete success during the year although by the end of the dry season the greater part of the surrounding country had been burnt. By arrangement with the District Commissioner, Livingstone, the District Commissioner's path through Sibulu Forest was closed on account of the fires originating thereon from passing natives.

31. The Ntebwe Dambo Plantation was successfully protected from fire during the year. A fire originating near the Mazabuka Aerodrome penetrated a *Cassia siamea* plantation at the Central Research Station. Less than an acre of one year old trees was scorched and has been replaced by sowings at stake.

Animals.

32. Hares and small buck caused damage to a plantation of two year old *Pinus longifolia* by eating off the tops. Field rats were troublesome at Bombwe Forest where they destroyed large quantities of seed and seedlings of *Baikiaea plurijuga*. Sowings at stake of seed of *Entandrophragma caudatum*, *Copaifera coleosperma* and *Pterocarpus angolensis*, suffered in the same way. The experience gained has led to the sowing of the seed at a greater depth. Baboons in the *Baikiaea plurijuga* forests destroy large quantities of immature pods of this species thus causing a greatly diminished seed fall.

Insects.

33. Small black ants have been observed to eat the cotyledons of *Baikiaea plurijuga*. Termites constitute the most serious pest of exotic trees in Northern Rhodesia. Eucalypts, *Casuarina* spp. *Grevillea robusta* are particularly susceptible to their attacks in the lower rainfall areas. A grasshopper defoliating Eucalypts at Mazabuka has been identified as *Phymataeus viridipes*, while a beetle, *Macropoda* sp., has been responsible for the decortication of shoots and young stems of the same species.

Fungoid Diseases.

34. A fungus having the appearance of *Armillaria mellea* has attacked *Cassia siamea* plantations on private estates particularly in shallow soils overlying a lateritic pan. Measures were recommended for combating the spread of the disease.

Climatic Injuries.

35. The exceptionally high flooding in the Kafue River was responsible for the destruction of a small plantation of exotic tree species on the bank of the Kafue near Mazabuka. The young trees, mainly *Eucalyptus* spp. were partly submerged for five months and very few recovered.

Legislation.

36. The schedule of Reserved trees under the Forest Ordinance, 1925, was further amended to include *Acacia albida*, *Ficus sycomorus* and *Tamarindus indica*. These trees supply useful timbers and their fruits are used by the natives in times of famine.

NATURAL REPRODUCTION.

37. The seed years of 1931 and 1932 were particularly poor in respect of Mukushi (*Baikiaea plurijuga*) in Bombwe Forest. Heavy flowering took place in October, 1932, however and a good seed fall in 1933 is confidently expected. This irregularity of good seed years renders the silvicultural improvement of Mukushi forests dependent on artificial regeneration by spot sowings in poor seed years, and in areas where mother trees are far apart or absent. It has been observed that considerable quantities of seed can usually be collected for this purpose from the large number of isolated Mukushi trees in the Livingstone municipality which are not influenced in their production of seed in the same way as the trees in the forest where root competition and the amount of seasonal rainfall are the important factors. In order to obtain data regarding the natural regeneration of Mukushi, experimental plots with control areas have been laid out in Bombwe Forest. Improvement-fellings and the removal of undergrowth have been carried out in varying degrees of intensity round suitable mother trees.

38. Natural reproduction from the seeding of a small plot of six year old *Cedrela toona* has taken place at Mazabuka and a quantity of the seedlings were pricked out into boxes for distribution and sale. Regeneration was also observed of the following exotic species: *Jacaranda ovalifolia*, *Melia azedarach*, *Gliricidia maculata*, *Cassia siamea* and *Poinciana regia*.

39. In connection with the tending of natural crops of *Baikiaea plurijuga*, a series of experimental and control plots were laid out in Bombwe Forest in different types of stocking. All trees in the plots were numbered and measured. Varying degrees of cleaning, cutting back of undergrowth and thinning were carried out with the object of determining the most suitable operation to be undertaken on a large scale. All experiments at Bombwe are concentrated on obtaining data for the production of a Working Plan capable of extension to other Mukushi Forests of the Kalahari Sand area.

40. By arrangement with the Zambesi Saw Mills, Ltd., who hold a concession over the Machili Forests, the property of the Paramount Chief of the Barotse, it was agreed that at least one mother Mukushi tree should be left per acre for regeneration purposes.

SOWING AND PLANTING.

Western Division.

41. The preliminary spot sowing experiments carried out in January at Bombwe Forest were sufficiently successful to warrant extended operations and, in December, 40 acres of Compartment E.B.3 were sown with seed of *Baikiaea plurijuga* at a square espacement of 6 feet, and 24 acres were similarly sown with *Copaifera coleosperma*. Small plots in old cultivation near the Divisional Office were also sown with *Pterocarpus angolensis*, *Pinus longifolia*, *Eucalyptus citriodora* and *Cassia siamea*. The latter species was also sown on either side of the logging railway to act as a fireguard. The cost of preparation of spots in the forest was 11d. per acre whilst the cost of sowing was 8d. per acre.

42. The establishment of *Baikiaea plurijuga* by the "Taungya" (field crop) method has been commenced at Bombwe and if successful will prove of great value in the restocking of large areas of poorly stocked forest. An area of three acres, partly in poor forest and partly in old native cultivation in the forest, was clear felled and burnt in native fashion. Mukushi seed was then sown in lines 7 feet apart and sorghum and millet were sown between the lines.

Northern Division.

43. Early in the year the Roan Antelope Copper Mines, Ltd., the Mufulira Copper Mines, Ltd., and the Rhodesian Selection Trust, Ltd., decided to abolish their Forest Section and to discontinue afforestation work on the Copper Belt. A great deal of the work of this private organisation had been devoted to investigating the possibilities of establishing on dambo areas plantations of trees, useful for mining purposes. The application of the data collected was embodied in the planting operations over 17 acres carried out in 1931 on the Ntebwe Dambo some nine miles from Luanshya. In order that the results of two year's applied study of methods of afforestation under special conditions should not be lost, the plantations were taken over by the Government Forestry Branch in June. The plantations are composed of *Cedrela toona*, *Cupressus lusitanica*, *Cupressus tomentosa*, *Eucalyptus citriodora* and *Pinus caribaea*. The latter species promises well and in December 3,000 plants from the abandoned nursery on the Muliashi Road were conveyed to Ntebwe to blank up 5.5 acres of the plantation. Spot sowings of *Pinus longifolia* and *Acacia mollissima* were also carried out in small trial plots.

Southern Division.

44. The nursery at the Central Research Station, Mazabuka, was maintained. During the planting season 1931-32, further species trials were carried out over 30 acres of land adjoining the nursery in order to determine tree species suitable for the comparatively dry conditions obtaining in the Division. As mentioned in the last report, the soils of the experimental area contain fairly high clay and silt fractions and are infested with termites, consequently the trials were not conducted under exceptional or favourable conditions. 34 inches of rain were recorded on the area between the middle of November and the middle of March, there being three spells of rainy weather each followed by a fortnight or more of hot dry weather.

45. 47 species of which 10 were selected species of Eucalypts and 8 species of Pine, were involved in the trials. At the end of the dry season the following trees showed promise: *Jacaranda ovalifolia*, *Cedrela toona*, *Melia azedarach*, *Thuya orientalis*, *Maesopsis eminii*, *Entandrophragma caudatum*, *Khaya nyasica*, *Pinus longifolia*, *Cupressus lusitanica*. All the Eucalypts were destroyed by termites, and *Grevillea robusta* suffered very considerably from this pest.

46. The hardiest of the Pines under trial proved to be *Pinus longifolia*. Although the rate of growth has so far been very poor it is hoped that inoculation with pine root mycorrhiza of new pine soils will produce the same stimulus to growth as has been experienced in Southern Rhodesia. Small quantities of inoculated

soil have been obtained from the nursery at Luanshya, the more preferable source of supply at Salisbury having been cut off by Foot and Mouth Disease regulations during the past two years.

47. The 15 acres of *Cassia siamea* plantations established by the Senior Agricultural Research Officer at the Research Station by spot sowing in January, 1929, have attained a height growth of 15 feet. Leaf shedding took place in July but fresh leaves were put out at the end of August. 60 acres of the same species were similarly established in January, 1931, and have shown vigorous growth. Pruning was carried out in 20 acres. The average height growth at December, 1932, was 11 feet.

North-Eastern Division.

48. Under the supervision of the Agricultural Officer, Abercorn, an area of 5 acres in "Chitemene" (native shifting cultivation) at Chifwani, in Native Reserve No. 5 near Abercorn, was laid out into plots for experimental afforestation with various exotic and indigenous tree species. Spot sowings of each species were carried out in burnt and unburnt plots but the value of the experiment was reduced by the lateness of sowing. *Entandrophragma caudatum* and *Uapaca Kirkiana* gave the most promising results. Further sowings were made at the end of the year.

SEEDS AND PLANTS.

49. Seed collected from indigenous trees amounted to 2,020 lbs, and 400 lbs. of seed of exotic tree species were purchased from South Africa, Amani and India. 330 pounds of seed of *Maesopsis eminii* were received through the courtesy of the Comite Special du Katanga. An exchange of seed was effected with Ceylon.

50. Free issues of 225 lbs. of tree seeds and 7,000 plants were made during the year to Government Stations, schools, missions, townships and farmers throughout the Territory. The Branch maintained contact with those to whom seed and plants were issued expressly for experimental purposes.

COLLECTION AND IDENTIFICATION OF SPECIMENS.

51. Over 400 botanical specimens were collected by the Assistant Conservator, Bombwe, chiefly representing the flora of the Kalahari sands. Forty-two important specimens were also collected by the Assistant Conservator, Ndola, during his tour in the Mavunda forests of the Mwinilunga District.

52. For purposes of identification or verification, 550 specimens were sent during the year to the Imperial Forestry Institute, Oxford, and complete determinations in respect of 388 specimens were received in return. Determinations of 26 specimens of herbs were also received from Kew.

53. The Branch has issued collecting instructions and has loaned botanical presses to interested officers of the Government and to private individuals in out-stations in order to accelerate the important work of listing the forest flora of the Territory.

54. The compilation of a check list of Northern Rhodesian trees and shrubs, with native names in all the principal languages, was continued. As a result of extensive collecting work on the Kalahari sand, the Sikololo and Chitoka check lists have been completely revised.

55. Collections of Northern Rhodesian timber specimens were supplied to the Imperial Forestry Institute, Oxford, the Forest Products Research Laboratory at Princes Risbough and to the Yale School of Forestry.

56. A series of microphotographs of East African timbers was received from the Imperial Forestry Institute. A table of uses of 50 of the more important indigenous timbers was published in pamphlet form by the Forestry Branch and distributed to timber consumers throughout the Territory.

ADVISORY WORK.

57. A considerable amount of the time of the headquarters office of the Branch was occupied in advisory work, and the increasing interest of the public in afforestation and allied subjects is recorded with pleasure.

58. An exhibit of native timbers with corresponding herbarium material was staged at the Kafue Show. The raising of trees in a forest nursery was demonstrated with boxes of seedlings and transplants and by a series of photographic illustrations.

59. Planting plans were drawn up for various missions and the Village Management Boards of Choma, Kalomo and Luanshya. In connection with the new capital site at Lusaka, the preliminary work of formulating a planting programme and establishing the necessary permanent nursery was carried out under the direction of the Forest Branch. Final plans having been approved, the work was placed in charge of the Provincial Commissioner, Lusaka.

60. The pupils at Codrington School were given a practical demonstration of the sowing and planting of trees and a lecture was delivered to the Lusaka School on "Forests and Forestry in Northern Rhodesia."

FOREST INDUSTRIES.

61. The Zambezi Saw Mills Ltd. continued logging operations in the Machili Concession Area. The forests of this region are the property of the Paramount Chief of the Barotse to whom compounded timber royalties are paid. The principal timbers exploited were *Baikiaea plurijuga*, *Pterocarpus angolensis* and *Entandrophragma caudatum*.

EXPORTS AND IMPORTS.

Exports.

62. The following table shows the value of exports of timber and wood manufactures for the years 1926 to 1931. The figures for 1932 are not yet available :

		1926	1927	1928	1929	1930	1931
		£	£	£	£	£	£
Unmanufactured	...	12,217	8,993	6,100	6,202	4,077	4,236
Partly manufactured	...	9	12	27	153	1,384	178
Joinery	...	94	89	1,813	1,465	553	91
Furniture	...	1,289	2,495	2,848	5,141	3,299	4,248
Other manufactures	...	27,980	2,605	2,629	3,475	14,113	26,993
<i>Totals</i>	...	41,589	14,194	13,417	16,436	23,426	35,748

Imports.

63. The following table shows the value of imports of timber and wood manufactures for the years 1926 to 1931. The figures for 1932 are not yet available :

		1926	1927	1928	1929	1930	1931
		£	£	£	£	£	£
Unmanufactured	...	24,728	23,344	20,366	62,328	98,183	58,502
Planed and grooved	...	4,419	4,998	6,502	10,828	12,767	10,361
Furniture	...	12,396	18,946	23,490	207	44,988	43,181
Joinery	...	8,291	9,936	24,798	31,538	33,562	27,277
Other manufactures	...	4,774	3,543	4,819	11,950	18,927	12,464
<i>Totals</i>	...	54,608	60,767	79,975	152,851	208,427	151,785

64. During 1931, 473,073 cubic feet of unmanufactured timber were imported. An analysis by countries of origin gives the following results :

		Cu. ft.	Percentage.
Sweden	...	116,531	24.6
South Africa	...	116,054 (mainly re-exports)	24.5
Finland	...	114,003	24.1
U.S.A.	...	49,768	10.6
Canada	...	38,817	8.2
Belgian Congo	...	31,856	6.7
Other Countries	...	6,044	1.3
		473,073	100.0

65. It is encouraging to note that our wood exports in 1931 showed an advance over the previous year, despite the slump in trade, while imports decreased to the value of £56,642.

REVENUE AND EXPENDITURE.

66. A comparison of the revenue, derived from timber royalties collected by the Department of Lands, with Forestry expenditure during the last five fiscal years is shown below :

		1927-28	1928-29	1929-30	1930-31	1931-32
		£	£	£	£	£
Revenue		2,971	2,458	3,757	850	417
Expenditure		994	641	1,376	1,854	2,740

67. It should be observed that the drop in revenue in 1930-31 coincided with the transference of the logging operations of the Zambezi Saw Mills Ltd. to the forests of the Paramount Chief of the Barotse to whom the royalties are credited.

DUNCAN STEVENSON,
Senior Assistant Conservator of Forests.

